Sketch of the habits of North American ants

Auguste Forel

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PSYCHE.

SKETCH OF THE HABITS OF NORTH AMERICAN ANTS.*— I.

BY AUGUSTE FOREL, CHIGNY PRÈS MORGES, SWITZERLAND.

Translated by A. P. Morse.

FAISONS, N. C., July 28, 1899.

To the Belgian Entomological Society,
Brussels.†

Dear Colleagues:

I am approaching the end of a myrmecological excursion in North America, and find myself here in the hot, low and marshy, almost sub-tropical region of North Carolina (between Goldsboro and Wilmington), under the hospitable roof of my good friend, Dr. Faisons, to whose family the village owes its name. I think that a report of the most interesting of the results I have secured will be welcome to you at your next meeting.

I have visited at Toronto, Canada; Worcester, Mass. (at the home of my friend and fellow-countryman, Prof. Ad. Meyer), Morganton (with my genial colleague, Dr. Murphy, director of the Insane Asylum), Black Mountain, and Faisons,— the three latter localities in North Carolina.

And first, a remark of general character relative to what has surprised me in the highest degree. In North America, with some rare exceptions, the ants do not construct mounds, either of masonry or of other materials.

In Europe, as you know, ant-hills abound in every meadow, in the woods, in clearings, among the mountains. On coming to a country where the fauna is so similar to that of our own, where so many species only differ from ours in characters often but little distinctive, where the tillage, the fields, the woods, closely resemble those of Europe, I was entirely taken aback when I observed that the varieties of our most common species: *Lasius niger*, *alienus*, *flavus*, *Formica fusca*, *sanguinea*, etc., do not build any masonry mound, but live in hidden, subterranean nests, opening only under stones or on the ground-level by a little crater. But the fact is the same from Canada to North Carolina. I was forced to submit to the evidence. However, the Americans know what an "ant-hill" is. When conversing with them, they refer to it as a great rarity which can be found in such and such a forest twenty or thirty miles away. And on going there you find a colony of *Formica exsectoides*, the only species in eastern North America which regularly

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* Extract from the "Rivista di Scienze Biologiche," vol. ii, no 3. Como, 1900.

† The first part of this article, as far as the appendix, is taken from the "Annales de la Société entomologique de Belgique," vol. 43, 1899.

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makes large, elevated conical mounds of earth in the forests. I visited two of these colonies in the vicinity of Worcester and of Black Mountain. The nests open by holes situated at the base and about the periphery. The workers do not make excavated roads like our *rufa* of Europe.

Besides these, *Formica fusca*, r. *subsericea* and *pallidefulva* rarely make small mounds. As for *subsericea*, so common everywhere, I have seen its mounds only at Niagara, at the side of the fall.

After mature reflection I have come to the conclusion that this singular fact does not seriously weaken my theory of the domes, but rather confirms it. In my "Fourmis de la Suisse," I have shown that the elevated dome is used by our ants to collect and concentrate on their larvae the radiant solar heat which they so much need, and I cited a number of facts in support of this view. But the climate of North America is entirely different from ours. Extremely cold in winter, it is burning in summer; there are extremes of which we in Europe have no idea. The ants consequently have quite enough heat and sunlight for their larvae. The dome is superfluous. What they do need is protection from extreme temperatures. For this purpose it is necessary either to mine deeply or to locate themselves in the shade and in the decaying trunks of forest trees. And that is what they do. At least it is in this way that I explain most readily this fact, so surprising by its generality.

Another fact to which Blochmann first called attention in Europe in connection with *Camponotus ligniperdus* is the following: The nests of ants abound above all on hill-slopes facing the east. I have confirmed this statement since then many a time, and here in America again. In this case also the explanation seems simple: The morning sun awakens the ants and urges them to work. After noon it is warm enough, they no longer need the sunshine. Hence the advantage of an easterly exposure which provides for a large amount of daily activity. Toward the west, on the contrary, they would lose the first hours of the morning, would be unable to work on account of the heat after noon in summer, and could do next to nothing in the evening to make up for it, once the night was come. Moreover, the night equalizes very quickly the eastern and western exposures, so that the latter do not even prolong the afternoon's activity among those species which work at night. Ants, then, have every advantage in securing sunshine in the morning and shade in the afternoon — in America as in Europe.

Let us pass on to some particular cases.

The species of *Formica* of Europe have American representatives. To *F. rufa*, *pratensis*, *truncicola* and *exsecta* of Europe correspond *integra*, *obscurifer*, *obscuriventris* and *exsectoides* of America. We have seen that *exsectoides* is the only ant of eastern America which makes large domes. It lives in colonies of five to twenty nests. McCook has seen 1500 to 1600 nests of it. The nests which I have seen were all quite conical and built almost exclusively of earth, with scarcely any commingling of leaves and fibrous debris. Some have a little more woody material. *Integra*, still larger, more dimorphic, of a handsome red with the abdomen ashy black, lives at the foot of trees or decayed trunks, fills the interstices of bark, etc., with woody debris and pine needles which stop up everything, without forming a dome rising above ground. The entire nest is excavated in the earth or in wood. This species rises upon its hind legs, curves the abdomen, like *pratensis* (this is not done by *exsectoides*) and ejects, as far as I have been able to observe, some venom while in this position. Dr. Faisons has shown me in a pine wood here at Faisons a considerable colony of about thirty nests of this species. These nests were connected with each other by tortuous roads quite similar to those of our *F. pratensis* of Europe, but narrower, deeper, and above all almost entirely covered, that is to say, carefully covered over with woody materials similar to those of the nest. Only at certain places were they uncovered for a length of a few centimeters. The fact is very curious and quite new; I think that they try thus to protect themselves from birds and other enemies. These roads lead to the trees and nests. The latter somewhat resemble those of *truncicola* of Europe. *Obscuripes* occurs only in the Far West; I have not yet found *obscuriventris.*

As Emery has shown, our slave-making *Formica*, *F. sanguinea*, is represented in America by several varieties. All those that I have observed at Niagara, Worcester, Morganton, Tyson's and likewise here, attack *Formica subsericea*, often much larger than themselves, and carry off the pupae. All the formicaries which I have observed have a large number of slaves, more than in Europe; the slaves in the nest are often more numerous than the *sanguinea*. I have seen several expeditions and two removals of *sanguinea*. The expeditions take place in the morning and the pupae are carried back in the afternoon. All this takes place as in Europe. I have seen some varieties having the epistoma but little emarginate make as many slaves as others having it deeply emarginate. At Mr. Tyson's (near Black Mountain, at the foot of Mt. Mitchell) when a large formicary of small *sanguinea* changed its nest, the *sanguinea* almost entirely alone transferred the *subsericea*.

The latter, although more numerous, were nearly all in the nest, and allowed themselves to be transported quietly. In the other removal which I witnessed, the case was the same. This is very striking, in America, on account of the large number of slaves, which are as numerous or even more numerous than their despoilers. In the High Park at Toronto I discovered, on the other hand, a large colony of *F. sanguinea* composed of numerous nests (more than a dozen), built against trunks of dead trees or by the roadside, and having not a single slave. These ants, of a deep red color, slightly emarginate, form their nests of rather woody materials, a little like *truncicola*. Their aspect was otherwise exactly like that of other *sanguinea* of Europe and America. They attacked and pillaged a bagful of *subsericea* and *pallidefulva*, which I placed near their nest, exactly as do other *sanguinea*, wild with desire like them, to carry off the pupae. The fact that these insects lived in a populous colony of many nests and had no slaves remains very curious, to say the least.

Formica subsericea, which corresponds to our *fusca* and is only a race of it, lives in the earth and in decayed logs. Only about Niagara have I seen any of its earthy domes, similar to those of its European congener.

Formica pallidefulva and its innumerable varieties excavate their nests in meadows and under stones.

Camponotus pennsylvanicus and *pictus* are very common in trees, the second in the north, the first everywhere. *Pennsylvanicus* runs rapidly on the roads and along the trunks, like our *pubescens* in the Valais. *Pictus* is timid and lives in small colonies in the trunks. *Marginatus* and its varieties live as with us in the bark of living trees, and *castaneus* is found in the ground, in the southern States.

Lasius alienus and *niger* live as with us but with neither domes nor chambers for their aphides. They mine solely and are more retiring, only making here and there little craters of sand. One finds them especially under stones. *Lasius myops* makes no dome at all. It is found under stones. In trunks in the woods is found a large *Lasius* of a dark and dirty yellow, related to *affinis* and making its nest in the worm-eaten wood of the trunks. The *Acanthomyops* make their nests deeply excavated in the fields. One discovers them only at swarming-time. In this way I secured at Morganton a species of it which is probably new.

Prenolepis imparis marches in regular files in going to its aphides. Its nest, excavated in the earth, is well hidden and so deep that I have been unable to reach the bottom of it.

Prenolepis parvula makes little nests everywhere, in wood, in dry leaves or in the earth, and runs about on the turf and in the forests.

Brachymyrmex heeri lives under stones, sometimes in the woods; it is widely distributed.

Dorymyrmex pyramicus is represented in the southern part of North America by two distinct races, *flavus* and *niger*. Both give off a very pronounced odor of Tapinoma (anal glands) and nest exactly like the *pyramicus* of tropical America, hunting in the same fashion. Here at Faisons I found a very curious mixed formicary of these two races. There were two or three nests of them several meters apart. The yellow workers and the black workers entered and passed out peaceably side by side, working together, and presenting every sign of friendship. The two forms were perfectly distinct — no transition form. I destroyed one of their nests to the bottom and was so fortunate as to find there males and females of *niger* and the male of *flavus*, the latter larger and paler. There is scarcely any doubt possible as to the following: This must be one of those rare cases of abnormal, mixed, natural formicaries which I described in my "Fourmis de la Suisse." But this case is certainly not of predatory origin, nor due to the carrying off of pupae as is the case with *Formica*. It was without doubt due to the fortuitous association of two fertile females, one of each of the two species, a state of affairs which I have already admitted possible for certain formicaries of *truncicolo-pratensis* and which is probable also in the association of *Tapinoma-Bothriomyrmex* which I have described (l. c.).

The American species of *Tapinoma* live exactly like those of Europe and possess the same odor.

At Morganton I found a little *Iridomyrmex* related to *humilis*, which runs with astonishing rapidity, following in file, hides its nest in the turf (like *McCooki*) or under a stone, and climbs trees to seek its food. It has a very strong odor of *Tapinoma*.

The American *Ponera coarctata* is very common in decayed trunks and under stones. I have made an observation upon it which is very difficult to make in Europe; but here it is quite constant. When one uncovers a nest of *Ponera* in a rotten tree one sees their yellow cocoons gathered in a corner, quite abandoned by the workers, which do not try to save them or collect them. On the contrary they take the greatest care of the larvae, which they carry off and hide. I suspect that among these ants, less social than others, the pupae escape unaided from their cocoons, without the assistance of the workers.

I found two *Amblyopona* in a rotten trunk and a *Proceratium* under the bark.

Two days ago, in cutting with a chisel into a rotten trunk in a pine wood, what was my surprise to find here at Faisons some *Eciton*. Two blows more showed me that I had had the good luck to fall upon a nest with its thousands of larvae and pupae.

To my great surprise all the pupae were naked, without cocoons, contrary to those which have been described and sent to me by W. Müller with *Eciton burchelli*. This little *Eciton*, of a reddish yellow, is related to *californicum* and without doubt described by Emery. I at once set to work to demolish the nest in order to discover the female, which is yet unknown (with the exception of *Pseudodichthadia incerta* André, of which the worker is unknown).

The trunk was literally impregnated with *Eciton* for a foot above and a foot below the soil. Not a square centimeter of rotten wood was exempt. I demolished everything, down to the ground under the roots, without finding the female. Finally, in looking over the debris, I found it, a long, broad, blind and wingless creature with immensely distended abdomen, moving slowly in the midst of the workers. Its thorax is narrow and somewhat rectangular. The pedicel has only *one* joint, very similar to that of *Labidus!* The characters are thus intermediate between the male and the workers. A leap for joy at this discovery.

About fourteen millimeters long at a guess. Mandibles sublinear, with parallel edges, without teeth, pointed at the end, slightly curved. Maxillary palpi two-jointed. Labrum emarginate. Scape short, strongly thickened in the second half. Segments of the funiculus longer than wide. Head rotundo-quadrate, with a wide longitudinal furrow from epistoma to occiput. Thorax narrow and elongate, especially the pronotum and mesonotum. Pro-mesonotal suture obsolete. Mesonotum oval, subdepressed. No scutellum or intermediate segment. Meso-metanotal suture distinct, concave in front. Metanotum wider than long, depressed, with a wide median impression on the basal face and two strongly rounded protuberances on each side. Basal face longer than the declivent face. Pedicel compressed from each side, wider than long, wider before than behind, with a superior face and two lateral borders. Its posterior edge is widely and deeply emarginate, forming thus on each side a broad obtuse tooth directed backward (form of *Labidus*). A broad, obtuse tooth beneath, in front.

The abdomen alone, both distended and elongate (the entire female is strongly elongate) is about nine mm. long. The pygidium and hypopygium form two wide, elongate disks, the first convex, the second rather flat and passing the first.

Eyes absent. Legs rather long, permitting locomotion. Tibiae and femora scarcely sub-depressed. The whole insect shining, finely punctate, except the thorax and the pedicel which are plentifully and more coarsely punctuated. Pile erect, fine, yellowish, abundant, pointed, generally distributed. Reddish. Legs and antennae a dirty yellow.

I placed a part of the nest in a bag in order to observe these interesting ants, and I have not yet finished studying them. Unfortunately there were in the nest only pupae and larvae of workers. I found a myrmecophile in it. The following observations seem to me important to record: The Ecitons carry their larvae and pupae, which are very elongate, by placing themselves astride over them with their six legs, like *Polyergus* but in a more accentuated fashion. Even the little workers carry the large pupae in this way, touching the ground only with the ends of the tarsi. But by so doing they travel very fast and have the antennae free. In the second place, their instinctive faculty of concerted action and of forming in line quite excels everything I have seen among other ants. Throw a handful of Ecitons with their larvae down upon strange ground. Under similar circumstances, where other ants scatter themselves about in confusion and require an hour or more (sometimes less) to arrive at any kind of order, to gather their pupae and especially to examine their surroundings, the Ecitons cooperate without losing a single instant. In five minutes they have formed distinct files of workers which do not wander from each other, carrying in part the larvae and pupae and traveling in a somewhat direct line, touching the ground with their antennae, exploring all holes and cracks until they find a cavity suited to their needs. Then the removal is executed with an order and celerity which is astonishing. As if by word of command the workers follow and understand each other, and in very little time everything is safe. There is no question of mutual transportation: it is more precisely the system of *Tapinoma.* The fact is remarkable in the case of a blind ant which has only its antennae with which to direct itself.

The American *Aphaenogaster* which I observed are all great hunters and subsist upon the insects which they catch. They are very fond of termites, and when one uncovers and scatters about a nest of termites in a wood, they hasten to feast on these succulent morsels. *A. fulva* is most common. It varies enormously and nests in rotten logs or under stones, especially in the forests, sometimes in rather large formicaries. *A. tennesseensis* makes immense formicaries in rotten trunks. I saw one of them near Niagara. In trunks of trees at Morganton and here, at their foot or under the bark, I found rather large formicaries of a beautiful species (*lamellidens* or *mariae*). Finally *A. treatae,* which abounds in the forests at Morganton, Black Mountain, near Mr. Tyson's, and here, in all parts of North Carolina, excavates little nests in the ground (never in logs), sometimes under stones. These nests open by a large, widely open hole, rarely two. The workers go out singly and are fearless hunters. The formicaries are not numerous. I found but one rather large one at Mr. Tyson's and the workers boldly attacked me when I disturbed it.

The American species of *Myrmica* have the same habits as the corresponding European forms and present nothing of interest. It is the same with *Leptothorax.* One species of the last makes its nest in curled up dead leaves on the ground. I found it by following a worker which bore a pupa. *Dichothorax* nests here at Faisons in small, dry, fallen branches among the dry leaves of the forest and feigns death. A *Myrmica* found at Mr. Tyson's and related to *M. rugulosa* also feigns death on every occasion.

I have just found here two formicaries of *Pogonomyrmex badius Latr.* (= *transversus* Sm. = *crudelis* Sm.). This species makes, in barren fields, a flat, rounded, dome-crater, covered with little stones. It stings in a terrible fashion. Having attacked it imprudently, I received two stings on the hand and suffer from them still, several hours after. Its stings are more severe and painful than those of our *Vespa germanica* of Europe. As has been remarked by Mrs. Mary Treat this species does not cultivate any special plant and makes no clearing around its nest by cutting down the plants. But Mrs. Treat was wrong in concluding from this fact that the same holds true for *P. molefaciens* of Texas. *P. badius* gathers several kinds of seeds; in demolishing its nest I discovered its granaries which are very flat, but well arranged.

On lifting up a stone at Black Mountain I saw a brown ant withdraw itself into a gallery. The magnifier enabled me at once to recognize *Atta* (*Trachymyrmex*) *tardigrada* Buckley! The mushroom garden of this single northern species of the group being still entirely unknown, I set myself in quest of it. The workers issued first in rather large numbers to defend themselves, especially when I placed before them some *Cremastogaster*. Soon I saw come up from the bottom of the nest some workers carrying little gray balls with which they obstructed the opening. I judged that these were from the mushroom garden and proved it by taking one of them in my forceps. Did they seek in this manner to repel the *Cremastogaster* by the odor of the mushroom? Did they wish to prepare for flight? I do not know. Some of them strangled several of the *Cremastogaster* with their mandibles. Finally I decided to open the nest to the bottom. It was not deep. It consisted of a large chamber the size of an egg and was filled with a mushroom garden which enclosed the pupae, several females, etc.

This nest recalled one made by some captive *Atta* (*Acromyrmex*) *octospinosa* in the earth under a saucer. It contained about two hundred workers. I placed a part of the mushroom garden in alcohol and tried in vain to make the mycelium of the rest grow in a damp vial. I shall send it to Prof. Moeller. McCook has claimed that *A. tardigrada* cuts off the needles of pines and firs. There were none of these trees in the vicinity of the nest. As *Trachymyrmex* makes a mushroom garden simpler than the other *Atta* and as their fungus is not Rhozites, I suspect that *tardigrada* employs other material (detritus, larval excrements, etc.) like the other species of the subgenus which I observed in Colombia.

The *Cremastogaster lineolata*, *ashmeadii* etc., of North America live, especially the latter, by preference in rotten trunks or in branches fallen to the ground in the forests. In these they make large formicaries. They are found under stones also, especially *lineolata*. They do not use dry, hard trees like *scutellaris* of Europe, so that their nests are easy to demolish. However, their habits are uninteresting, like those of nearly all *Cremastogasters*.

The species of *Pheidole* are numerous and live under bark or in the earth in excavated nests with small crater-like openings. At Black Mountain a species makes large, almost dome-like nests which are very populous. Here at Faisons I have found several species of them under bark. At Morganton I witnessed the marriage-flights of the males and females which appeared in swarms in the early evening in front of the Asylum.

Monomorium ebeninum is very common and lives here, as in the Antilles, in dry branches, very often in those fallen to the ground in the forests. I witnessed a removal.

Various species of *Solenaspis* live in double nests as in France and elsewhere with various large ants, especially with *Formica exsectoides*, *subsericea*, etc., but very often with termites also, particularly in rotten trunks where they insert themselves between the passages of their victims.

I cannot finish this short notice of the habits of the North American ants that I have observed thus far, without thanking most sincerely my good friends and colleagues Dr. Ad. Meyer of Worcester, Dr. Murphy of Morganton, and Dr. Faisons of Faisons, to whose aid, hospitality and inexhaustible kindness I owe all that I have discovered. Now I go to visit the able American myrmecologist Mr. Pergande at Washington and thence return to Europe.

LIFE HISTORIES OF NORTH AMERICAN GEOMETRIDAE. — XXIV.

BY HARRISON G. DYAR, WASHINGTON, D. C.

Eois inductata Guen. The moth from which these eggs were obtained was in very poor condition and the larvae died before pupation, but I believe that the determination is correct and that there are no more larval stages. There is no previous description of this larva.

Egg. Long and nearly cylindrical, less in one diameter but not with any flattened surface; one end first a little bulging, then tapering to a round blunt point, wedge shaped from side view, the other end (micropylar) roundedly truncate. About eighteen longitudinal ribs, fluted at the joinings of the faint regular cross-striae which form square cells. Ribs diminishing by a few before the ends; micropylar end coarsely irregularly reticulate. Pearly white, looking beaded from the fluted ribs. Length .9, width .4 × .3 mm. The next day turned pink, shading to red at the truncate end.

Stage I. Head rounded, free, slightly bilobed, luteous, faintly mottled with brown; width .3 mm. Body slender, whitish, a rather broad, even, brown-gray dorsal band, separated on joints 2 to 4 into four diffuse lines, but soon merging into a single, broad dorsal band to joint 13; a broad subventral band, the pair separate. Tubercles pale, nearly obsolete; setae short, dusky with small enlarged tips. Feet pale; segments finely, about 20-annulate. Anal flap pale. Segments scarcely enlarged centrally, uniform, smooth. After feeding turned greenish by transparency.

Stage II. Head round, scarcely bilobed, free; whitish, a white stripe on the face of each lobe, containing an isolated brown dot opposite middle of clypeus; many brown dots filling the median suture and apex of clypeus, also on the outer side of the white band; labrum pale; ocelli and tips of antennae brown-black; width .4 mm. Body moderately slender, smooth, normal, segments, numerously (about 20) annulate, but not distinctly; setae short, black, rather coarse. Dorsum broadly dark brown, cut near its edge by a linear, slightly flexuous, pale yellowish subdorsal line, most distinctly at the ends and in incisures; sides pale green; a broad subventral band, colored like the dorsal one and slightly intensified at tubercle vii on each segment. Venter pale green rather narrowly. Cervical shield more reddish than the rest of the dorsum. Feet all pale.

Stage III. Head rounded, not bilobed, held out flat, free from joint 2; antennae rather large, divergent, straight; white with broad bands of brown mottlings, one on side of lobe and one next the median suture; suture itself brown as also the clypeal suture above; antennae black tipped; width .6 mm. Body moderate, segments about 30-annulate, rather obscurely. Dorsum broadly brown, pulverulent, cut by narrow pale subdorsal line and on joints 2 to 5 by a dorsal line also. Shields concolorous, the anal plate pale at the sides. Subventral fold white, slightly yellowish. A broad subventral purple-brown band, emphasized below the spiracle by a darker patch; a nearly contiguous pale line below this band; venter narrowly white. Feet pale outwardly; setae short, black; tubercles minute.

Stage IV. Head white with brown dotted bands as before; width .9 mm. Body moderate, uniform, finely annulate. Dorsum dark brown, a fine white subdorsal line continuing the white of head; a paler brown lateral band in part contiguous to a still paler suprastigmatal one. Subventral fold white, a trace yellowish. A geminate subventral pale brown band, the upper half containing a nearly black dot below and before the spiracle. Venter not broadly whitish. Feet pale, the abdominal ones faintly brownish marked. No discolorous shields.

Stage V. Head erect, rounded, higher than wide, scarcely bilobed, antennae distinct; whitish with a brown shade, black dottings on each side from ocelli to vertex and between the lobes over the median suture; sutures of clypeus dark; width 1.1 mm. Body slender, the segments moderately drawn out, the central ones about 25-annulate, uniformly, annulet 1 somewhat larger. Whitish, dorsum pulverulently brown shaded, forming a dark geminate dorsal line, diffuse outwardly, followed by a pale subdorsal line, on the abdomen faintly, but on thorax and joint 5 distinctly edged by dark dottings. A whitish band on subventral fold; a vinous brown spot below it a little in front of the spiracle, distinct on joints 5 to 7, faint on 8 and 9. Feet pale or a little brownish dotted, the anal ones elongate triangular. Tubercles minute, dark; setae short, dark, slightly enlarged before tip. Spiracles brown rimmed. There are some secondary setae present, forming about twenty hairs in all on each side of a segment, all alike in size and color. Most of the extra ones are subdorsal in a continuation of the line of i and ii and subventral posterior.

Food plant unknown. The larvae fed on rag weed and clover. Moth from Washington, D. C. Eggs June 1, last larval stage July 1, but all died soon after without pupating.

A NEW USE FOR AN OVIPOSITOR.—A female *Deidamia inscripta* emerged in one of my boxes and in some way injured the first two legs on one side. After two or three days I noticed that when the moth hung from the lace over the top of the box it clung with the remaining legs, and thrust its ovipositor up through a mesh of the lace bending its tip forward so that it held like a bent finger. In this position the moth rested for many hours daily. *Caroline G. Soule.*

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SKETCH OF THE HABITS OF NORTH AMERICAN ANTS — II.

BY AUGUSTE FOREL, CHIGNY PRÉS MORGES, SWITZERLAND.

Translated by A. P. Morse.

Appendix to the preceding letter (*unpublished*).

After sending this account to your Society I made a visit to Mr. Pergande and compared in part my gatherings with his collection. The *Eciton* is *E. carolinense* Emery.

I forgot to say that the *E. carolinense* had only larvae and worker pupae in the nest. I could find the larvae of neither males nor females, which is much to be regretted.

The conclusion of my journey presented still other interesting facts, which follow:

Arrived at Washington, on the way from Faisons, I was received in most welcome fashion by my estimable colleague Mr. Pergande, entomologist of the Dept. of Agriculture of the U. S. Mr. Pergande aided me in finding numerous species of ants whose dwellings he knew and his beautiful collection afforded an opportunity to make instructive comparisons.

A small *Formica* found near Mr. Tyson's in a very small nest of woody materials, like a miniature of *F. integra* and its nest, is *F. difficilis* Emery. I took its curious yellow female also. It has exactly the appearance of *integra* and *pratensis*.

I discovered also the beginning of a formicary of *Camponotus marginatus* Latr., that is to say the female alone with some cocoons.

Then Mr. Pergande showed me in the earth the nests of a black *Monomorium* different from *ebeninum* (*carbonarium* var.?; *minutum* according to Emery), with the *metanotum* rounded. I have found it since then frequently, nesting in the ground, while *ebeninum* seems to nest regularly in dead wood and hollow stems.

A nest of *Formica obscuriventris* Mayr was constructed like those of *integra*, but I saw no roads.

In hunting under logs along the Potomac we found *Stenamma diecki*, *Strumigenys clypeata*, *Proceratium crassicorne*, and other rarities of secluded habits. Even in the streets of Washington two formicaries of large *Tetramorium caespitosum* L. waged deadly war against each other on the sidewalks, a habit of these ants as McCook and I have already described.

At Cromwell, Ct., where I stopped afterward, I found some colonies of *Formica exsectoides* with more woody materials. I placed a handful of *exsectoides* from a nest in a wood, about five hundred paces from another, toward the latter, in order to discover if they were of the same colony. Some workers seized the newcomers for an instant by the legs. Aside from this, peace and fusion. The experiment is not, however, conclusive, because in Europe we see *F. exsecta* of different colonies behave in nearly the same manner.

By making some *F. exsectoides* fight with other species (*pallidefulva* and *sanguinea*), I was able to ascertain that they have not, like *exsecta* of Europe, the instinct to seize their enemies by the neck, in order to saw it apart. Their analogy with their European congener is, therefore, only partial.

At Cromwell, in the brush of a cleared woodlot, I had the good fortune to be present at the attack on a formicary of huge *F. subsericea* by a feeble band of *F. sanguinea*, smaller and much less numerous. The *sanguinea* were scarcely thirty in number and a third of them were recently enclosed workers, still immature. Evidently it was a newly started formicary which was thus engaged. The *subsericea* had their nest at the foot of a large mullein (Verbascum). In number they were at least tenfold their aggressors. Each of them was, I can affirm, as well armed and on an average larger than and equally as robust as any of the assailants. Well, the mere arrival of this little troop of *sanguinea* was sufficient to spread a panic in the formicary of *subsericea* which fled with their larvae and pupae without attempting any serious defense, allowing the *sanguinea* to seize their young and take possession of their nest. Only one or two small *sanguinea* were killed. The instance is noteworthy because in this case neither the formidable weapons, the violence, nor the impetuosity of the little band of *Polyergus rufescens* whose similar aggressions I have described in my "Fourmis de la Suisse" can be alleged. The bold and courageous tactics of the *sanguinea* were even somewhat less marked than among those of Europe, which fight with species smaller and weaker than themselves. I have never seen a cowardice so absurd or so complete as that of these American *subsericea*, and this cowardice indicates very clearly the instinctive adaptation of the slave-making species to attack and of the enslaved species to flee.

At Hartford, Ct., I discovered a small mixed formicary of *Formica exsectoides* and *F. subsericea*. There was scarcely any doubt of the common and intimate life of the two species in the same nest. They went in and out at the same doors, etc. Here the artificial experiments of a myrmecologist were excluded. This case is undoubtedly the same as that described for the first time in my "Fourmis de la Suisse," that is to say, an abnormal, mixed, natural formicary resulting from a battle between the two species, a battle in which *exsectoides* had the best of it and had raised the pupae taken from *subsericea*. Here, as in Switzerland, the mixed formicary was not populous, much less so than those of *exsectoides* usually are. The nest was small. I believe it necessary to be cautious and to ask if the apparent association of different species of *Formica* is not also due at times to the association of fertile females of the two species. The fact could, on occasion, be verified. At Hartford time did not permit me to do this.

In the suburbs of Boston (Franklin Park) I found among others a *Strumigenys*, some *Brachymyrmex heeri*, a *Cremastogaster*, and a solitary worker of *Polyergus lucidus*, a fact which is astonishing if one considers that the latitude of Boston is nearly 45° N. [more nearly 42° 20′] (nearly the same as Turin), and that it is much colder than in the same latitude in Europe. Now these genera of ants love heat.

In the old world the number of species is less in continental than in maritime climates. Thus the ant-fauna of Bulgaria is much scantier than that of the south of France. Besides, the fauna there is upon the whole less southern. But it is necessary to take into account other factors without which one cannot understand why the fauna of North America, in spite of the continental climate of the country, is so much richer than ours.

However, one finds, even with us, some exceptions. Thus *Myrmecocystus viaticus*, a southern form, extends farther north in eastern Europe (continental climate) than in western Europe (maritime climate). This species, therefore, stands a rigorous winter well provided it has a hot and dry summer, while with others it is for the most part the contrary. But it is evident that for America there are some facts of prehistoric geological geography which have contributed to preserve there a fauna and flora very much richer than in the Old World. This fact is well known and of great interest, considering the close relationship between the nearctic (North American) fauna and flora on the one side and the palearctic (northern Old World) fauna and flora on the other, a relationship which is antecedent to the glacial epoch, when the two faunae were connected by Greenland. Moreover, one observes some facts in America analogous to those of the Old World. Thus North Carolina has in its western part a distinctly continental climate, while in the east the Gulf Stream gives it one of somewhat maritime character. Now, the ant-fauna of the state is much richer in the east than in the west. It is true that the western part is also somewhat more elevated; but the mild winter is without doubt the principal cause of this wealth.

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